APPENDIX

AUTOMATIC DATA PROCESSING

I. Introduction

Considerable uncertainty exists in relating the capabilities inherent in automatic data processing and the potential value of their application in imagery interpretation.

It is important to recognize that a recent estimate by COMOR indicates that about 90% of national intelligence objectives can be satisfied with imagery having resolution near that now available. Further, it appears that the imagery now available is not completely exploited. It may be assumed that the reason for this reflects a judgment relating to the diminishing returns which may be expected from this unexploited imagery against the current costs involved. One important task for automatic data processing as applied to imagery exploitation is to refine these vast amounts of "low grade ore" not currently exploited at a cost which can be justified by the value of the product. This may be realized in several different ways, but particularly by:

a. Significantly improving the value in quality and quantity of the imagery interpreters output, and

b. Permitting valuable things now undone to be accomplished through ADP.

This appendix is focused primarily on the unique problems of imagery interpretation to which automatic data processing techniques may be applied. In some instances, explicit references are made to other discussions which treat more fully the applications of ADP in the organization and management of tasking, improved access to collateral data, report preparation and distribution, and other functions which are identical to, or are closely related to

ADP applications and other types of intelligence processes.

II. Computer Functions

The tasks which can be performed by computers may be cstegorized several different ways. However, these basic capabilities as applied to imagery interpretation may readily be considered as:

a. Data storage and retrieval

b. Translation

c. Processing

d. Communications, display, and report preparation

e. Computing

f. Management functions

These various capabilities will be discussed in terms of their relationship to the imagery interpreter.

III. Applications to ADP to Imagery Interpretation

A. Direct Assistance - Storage and Retrieval

Automatic data processing can improve and extend the library service for the imagery interpreter. Rapid and complete access to collateral information or to imagery data which has been stored as a base can be provided. Generally, this material may be made available through a selective subject index, a geographical index, or various other indices which may be suitable for the intelligence function which is being performed. There does not appear to be a technical impediment to providing any degree of storage and retrieval capability which may be desirable and economically worthwhile. Unfortunately, this very straightforward application of ADP has been

obscured in the past by technically interesting but operationally trivial differences in points of view of various individuals and organizations. The difficulties in reaching a decision on film chip size typifies this problem. There has been considerable controversy for some time on the size of film chip which should be used in imagery interpretation. Decisions on the engineering design of equipment to handle these film chips have consequently not been made. The technical aspects of this problem may be simple, and far less significant than the necessity for a decision on the size, or sizes, of film chips for automatic storage and retrieval systems.

B. Direct Assistance - Processing

Direct assistance to the imagery interpreter is currently provided in making measurements. A computer can readily be programmed to provide mensuration data on a real time basis taking into account the several necessary factors. The process of mensuration, like that of storage and retrieval, is technically straightforward and poses no particular problems. In addition to performing the relatively straightforward calculations which are required, including the look-up in the data base to obtain the particulars of the reconnaissance flight which are required for the calculation, hybrid configurations of equipment may be devised to improve the pointing accuracy which critical in the mensuration process.

Automatic data processing techniques may be designed so that the various parameters of imagery may be adjusted to enhance the

imagery interpretation processes. For example, changes in the H&D curve, latitude, etc., may be adjusted in real time along with scale and other dimentional factors. This may be done using automatic data processing techniques coupled with electronic display devices which are currently available and compatible with digital systems. This is especially significant for third-phase exploitation.

Once an imagery data base has been established, as discussed elsewhere in this report, it is possible to automatically view new imagery and compare it with the data in the imagery base to determine whether or not changes in the imagery have occurred. The threshold or sensitivity to change can be adjusted to the particular problem. For example, changes may be restricted to variations in lengths of lines, variations in the sizes of built up areas, etc.

Numerous techniques for automatic target recognition have been developed in the past which are applicable to imagery interpretation. Like change detection, the threshold for recognition may be adjusted to any desired value. As confidence that all of a particular type of target be recognized is increased, the probability of false alarm and the requirement for imagery interpreter time also increases. Nevertheless, these techniques may serve to provide counts of various types of objects over very large areas and may be very useful in many other applications.

A significant function for which automatic data processing

equipment is highly effective, but not now used in imagery exploitation, is correlation, especially multi-sensor image correlation, to provide additional depth of identification on particular types of targets. In addition to improving the probability and certainty of target detection, such techniques may be programmed along adaptive lines and can provide information on trends in target characteristics.

Ultimately, automatic data processing systems may be adapted to handle new imagery data against a vast reference data base employing several different types of sensor data. This represents the most powerful interpretation application which is foreseen at this time. It is also a technique well beyond the scope of the unaided human because of the human limitations in handling the quantity of information which the data base involves.

C. System Assistance

Through automatic processing techniques, the effectiveness and efficiency of the collection systems may be improved in a way to reflect directly in reducing the imagery interpretation work load. An immediate capability exists for automatic plotting of imagery interpretation coverage. This can be achieved by a combination of accurate automatic plotting of the navigational data with subsequent refinement of geographical coordinates through imagery matching against the existing data base. Applicable techniques for this have been highly developed in optical and radar missile guidance systems,

and are generally referred to as automatic map matching.

Image quality must be considered in two ways: from a purely physical point of view which takes into account the physical characteristics of the object viewed, the intervening optical path, the camera mechanism, and the processing; and from a subjective viewpoint which relates factors such as contrast "snap" or "crispness" which will vary considerably, depending upon the personal preferences of the image interpreter involved. Although complex, the physical parameters should be, and can be, readily assessed in concrete terms. Data on these physical characteristics of image quality are important so that meaningful data for equipment design can be derived from interpreter performance. Although the subjective assessment of image quality will involve a number of different parameters, these may be readily related through automatic data processing techniques, in a meaningful way, to the physical measurements of image quality.

D. Management

It is noted in the introductory paragraph, executive management decisions now determine the extent of imagery exploitation. The efficiency of the manpower available for imagery exploitation may be improved through real-time control of tasking, and control of production so that duplication of effort is precluded. The technology for accomplishing this is relatively simple, but requires development of an appropriate vocabulary so that a reasonable number of de-

scriptors can adequately define the work in process.

The efficiency of the imagery interpreter may be improved through improved communications and display devices so that direct communication between imagery interpreters and analysts is possible via common communications links. Hopefully, this will permit analyst access to the imagery data base. Although this will not reduce the imagery interpreter's time for basic work, an increase in efficiency once this material has been classified and stored may be envisioned.

The automatic data processing equipment suitable for performing the various functions described above may also be used to perform a number of "bookkeeping" tasks so that statistics may be readily derived to permit further evaluation and refining of the imagery interpretation process.

IV. Recommendation

The types of imagery interpretation tasks which can be substantially assisted by automatic data processing techniques have been discussed. Table I extends this discussion by indicating those functions which are common to many activities in addition to military or intelligence tasks, those which are unique to intelligence and those which are unique to imagery interpretation. In addition to these definitions, the Table indicates those functions which would be of primary interest for national uses and those which may have an additional use in strategic or tactical military processes. A classification is also made to indicate the degree to which the ADP equipment for the particular

function may be essentially independent of other automatic data processing equipment.

Several factors are immediately apparent. Those functions which demand high data base capacity are not peculiar to intelligence or to imagery interpretation; only three functions peculiar to imagery interpretation are important to both national as well as military uses, and two of these functions may be performed with semi-automatic ADP equipment which may be relatively indepdendent from other ADP equipment.

In view of the fact that the Government has extensive ADP programs directed toward the problems of massive data manipulation and management applications, it is expected that adaptations of this equipment and software will suffice for the library service, pattern recognition, vast data base manipulation, direct coverage plot, tasking and production control, communications and display, and the normal business functions associated with imagery interpretation. The effort required to adapt the software, while straightforward, may be large and expensive.

Recognizing further the military ADP projects, of which those associated with intelligence are a significant part, it is evident that the imagery interpretation community must assume responsibility and take the initiative in the areas of mensuration, parameter adjustment, change detection, pattern recognition or target recognition, and must participate in structuring of library services - both input and output.

Mensuration equipment should generally be designed to operate on a time sharing basis with the main facility computer or an available tactical computer.

The input-output devices, however, associated with mensuration are not so demanding as to require common computers among those facilities which may be engaged in this work; consequently, coordination through common measurement devices design and dissemination of information on software is an appropriate procedure for avoiding duplication and obtaining the best techniques and systems in this area.

Parameter adjustment refers to an electro-optical ADP device which can change scale, contrast and various other parameters as desired while viewing a photograph in order to enhance interpretation. Such equipment may be generally independ of any facility or tactical computer installation. Equipment for tactical use may allow variation of only a few parameters, whereas equipment for permanent installations should be very flexible. A common design effort for equipment for permanent installations is obviously desirable, and equipment designs for tactical use should derive design criteria from the more complex equipment. Coordination of design and procedurement of tactical equipment may readily be accomplished by normal COPE procedures.

Target recognition is generally similar to parameter adjustment equipment from the standpoint of coordination and design characteristics, etc., and a similar recommendation is made for these devices.

In summary, the imagery interpretation community should:

a. Initiate aggressive programs in the areas of mensuration, parameter adjustment, and target recognition work.

b. Closely monitor ADP design and development in other areas, and sponsor wuch work as may be necessary to adapt progress in these fields

to the imagery interpretation requirements.

c. Recognize that commonalty of ADP equipment for imagery interpretation does not seem to be indicated, although this would be desirable providing the functions of the other organizations involved were not jeopardized in the process.

d. Coordinate ADP work for imagery interpretation support so the limited budget available for such work is not fragmented and therefore ineffective in achieving the desired goals. This can be accomplished by requiring the proposed National Imagery Exploitation Authority to established a sub-committee on ADPs for the purpose of providing an effective coordination mechanism in the intelligence community and with the other instrumentalities such as CODIB and COPE which have nested interests in problems of mutual concern.

e. Establish a centralized imagery derived information data in NPIC as outlined in Annex B of the Appendix.

Annex A.

	Common	Intel Peculiar	P. L. Peculiar	Primary Nat'l Use	Primary Tactical Use	Independent or Semi-Ind.
LIBRARY SERVICE	X			X		
MENSURATION			X	X	X	
PARAMETER ADJUSTMENT			X	X	X	X
CHANGE DETECTION		X		X		X
TARGET RECOGNITION			X	X	X	X
PATTERN RECOGNITION (CORRELATION)	X			X		X
VAST BASE MANIPULATION	X			X		
DIRECT COVERAGE PLOT	X			X		X
IMAGE QUALITY MEASURE			X	X		X
TASKING & PROD CONTROL	X			X		
COMM. & DISPLAY	X			X	X	
NORMAL BUSINESS FUNCTIONS	X			X		

NATIONAL IMAGERY INTERPRETATION INFORMATION BASE

NATIONAL IMAGERY INTERPRETATION INFORMATION BASE

I. Introduction

The establishment of a centralized imagery derived information data base is considered an intregal part of any national tasking plan. In fact, the image interpretation organization of the intelligence community should fully exploit the opportunities afforded by the next generation of computers which offer "on-line" data files and rapid access to comprehensive information files by both the finished intelligence producer and the imager interpreter from remote locations. A National Imagery Interpretation Information Base can significantly assist in satisfying the intelligence collection and production activities needs at the national level.

An imagery interpretation data base is important to finished intelligence analysts, but is critical to the imagery interpreter during all phases of his exploitation process. To provide more timely and accurate reporting and at the same time cope with the increased volumes of film inputs, a central computer-based bank of imagery derived or related information is required. First- and second-phase reporting can be accomplished within the framework of a human-readable, machine-processable system. Automated systems now permit new information to be related to the accumulation of past reporting. However, products being disseminated as a result of first and second-phase reporting do not reflect the interplay with the total imagery interpretation base. Future reporting should place less reliance upon cumbersome hard copy dissemination practices, and strive for full utilization of automated processes of information handling.

information handling.

II. Establishment Of A National Imagery Interpretation Information Base

Several documents and directives such as have made reference to maintenance of files of photographic data. As a general rule, these documents have treated data base maintenance as an ADP problem without regard to the intelligence purposes to be served and the three contribution phases of imagery exploitation. Nevertheless NSCID No. 8, DoD Directive 5105.21 and DCID No. 1/4 provide adequate guidance for the establishment of a National Imagery Interpretation Information Base.

NSCID No. 8 assigned the responsibility to maintain a consolidated file, on a selective basis, of photographic data as a service of common conern, and further states that the NPIC "shall make appropriate recommendations to facilitate the coordinated development of compatible codes, indexes, and mechanized systems for the efficient recovery, selection and collation of available photographic data."

The Defense Intelligence Agency has been assigned, in DoD Directive 5105.21, overall responsibility for establishing and maintaining a non-duplicative DOD-wide intelligence data base.

As a service of common concern, NPIC has the primary responsibility for establishing and maintaining a consolidated, centralized imagery interpretation data base.

As noted earlier, first- and second-phase reporting provides most inputs to the information data base. The NPIC has accumulated most experience in first- and second-phase support to national level needs, and the present NPIC

Target Brief File, although limited in scope, constitutes a well-developed, highly accepted, imagery interpretation base.

III. Organization Of National Imagery Interpretation Information Base And Its Composition

The National Imagery Interpretation Information Base (NIIIB) should consist of at least four files:

1. Installation Data File - Information derived from imagery on individual installations or targets to include readout data and photo reference data.

2. Area Coverage File - Information derived from imagery on geographic area coverage.

3. Imagery Interpretation Product File - Information on all products produced by imagery interpretation organizations of the U. S. Intelligence community.

4. Management Information File - Information related to manpower application, resource inventories, material inputs.

These files would be maintained by the NPIC for the mutual support of the imagery interpreters intelligence analysts of the community. Inputs to the various files would be made by the NPIC, CIA/IAD and selected imagery interpretation elements of the DoD (See Annex 1). Primary input responsibilities would be consistent with assigned production responsibilities as outlined in the National Tasking Plan.

Coordination and validation of inputs to the National Imagery Interpretation Information Base, NIIIB, should have the following characteristics:

1. The organization designated "file coordinator" will be responsible for exercising quality central, validity information and processing inputs into the NIIIB.

2. No imagery interpretation organization subordinate to a member of the USIB will be denied the opportunity to make inputs to the NIIIB.

3. The file coordinator will have the responsibility for designating inputs "national" or "DIA/CIA/NPIC departmental only".

4. A "_____DEPARTMENTAL ONLY" input will be made to the NIIIB only after the originator has been informed of the file coordinator non-concurring with the proposed input and the file coordinates will not make the departmental input without the approval of originator.

A brief outline of the flow of information into and out of the separate files of the NIIIB is contained in Tabs 1-4.

Target-made-good reporting photo index data, new and change information, and order-of-battle intelligence support resulting from Phase II will continue to be a major need of the national intelligence community.

Mission index data is needed in the computer data base so it may be related to past data and rapidly transmit new and selective index data tailored to the specific needs of the consumers.

All phase II derived geographic coverage index data such as (MCD) should be rapidly and systematically added to the imagery index data base and be available for retrieval upon a selective query basis by the diverse elements of the intelligence community.

Analysts must have the capability to rapidly and selectively relate new and change data on a single mission to the total intelligence base. Timely dissemination of new and change information and rapid access to an up-to-date computerized imagery data base are necessary requirements.

Order of Battle information should be quickly entered in the computerized imagery data base so elements can rapidly relate the latest OB data to all or portions of the total II base.

V. Advantages of The National Imagery Interpretation Information Base

1. Provides base for rapid, accurate first- and second-phase reporting.

2. Essential to any computer-based reporting system.

3. Provides a single point for retrieval of II derived information.

4. Promotes reporting standardization and improved quality of reporting at National level.

5. Provides mechanism for mutual support and decrease of duplication.

6. Provides an authoritative imagery derived information base.

7. Provides a capability to integrate inputs from image interpretation units throughout the government.

8. Provide a mechanism for identifying, and controlling unnecssary duplication in research and reporting.

9. Provide a consumer oriented service capability through the service center concept.

10. Takes advantage of current state-of-the-art in communications.

TOP SECRET

WORKING PAPER

CONTROL NO. _____

REFERRED TO OFFICE	RECEIVED			RELEASED		SEEN BY	
	SIGNATURE	DATE	TIME	DATE	TIME	NAME & OFFICE SYMBOL	DATE

Handle Via Indicated Controls

TALENT-KEYHOLE

.....

.....

.....

.....

WARNING

This document contains information affecting the national security of the United States within the meaning of the espionage laws U. S. Code Title 18, Sections 793 and 794. The law prohibits its transmission or the revelation of its contents in any manner to an unauthorized person, as well as its use in any manner prejudicial to the safety or interest of the United States or for the benefit of any foreign government to the detriment of the United States. It is to be seen only by personnel especially indoctrinated and authorized to receive information in the designated control channels. Its security must be maintained in accordance with regulations pertaining to TALENT-KEYHOLE Control System.

TOP SECRET